Food and feeding habits of *Synodontis nigrita* from the Osun River, SW Nigeria

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Abstract

An investigation was conducted into the food and feeding habits of *Synodontis nigrita* from the Osun River near Epe, Lagos, Nigeria. The food items in the stomach of the *S. nigrita* covered a wide spectrum, ranging from various types of plankton to invertebrates and plants. A seasonal variation was also noted in the stomach contents of *S. nigrita* over the period of investigation. The predominant food items found in the stomach were *Polycystis* spp., *Closterium* spp., *Oedogonium* spp., plant tissues, insect parts and detritus. This suggests that *S. nigrita* is an omnivore.

Introduction

Nature offers a great diversity of organisms that are used as food by fish and these differ in size and taxonomic group. Various investigations have been conducted into the food and feeding habits of fish with the aim of determining their dietary requirements. Fish (1955) found *Tilapia esculenta* in East Africa to be feeding mainly on diatoms, a mixture of phytoplankton and zooplankton, while algae and diatoms were reported by Fagade and Olaniyan (1978) for the same species. *T. guineenses* and *T. mariae* have been reported to be omnivorous (Fagade 1971; 1978) and *Ethmalosa fimbriata* (African shad) as zooplankton feeders (Fagade and Olaniyan 1973). The food and feeding habits of many predatory species have also been reported. The species *Hydrocynus forskalii* (tiger fish), *Hepsetus odoe* (African pike), *Channa obscura* (snake head) and *Lates niloticus* (Nile perch) were found to be principally piscivorus in all studied habitats (Holden 1970; Aramowo 1976; Adebisi 1981) suggesting they are obligate piscivores and feed mainly on cichlid fish.

Although a sizeable amount of literature exists on the food and feeding habits of fish in most inland water bodies, there is still paucity of information on the dietary requirements of *S. nigrita*, also known as spotted upside down catfish and called *akokoniko* in the Yoruba language. It is noted among the local riverine people as a palatable fish with high protein content and is in great demand. However, its armor-like head makes it bony in structure. The present study aims at investigating the food and feeding habits of *S. nigrita* in the Osun River, Nigeria.

Materials and methods

The Osun River has shallow water with a depth of about 1.5 m proximal to the point where it empties into the lagoon. Samples of *S. nigrita* (321) were obtained from the Osun River near the Epe Lagoon in SW Nigeria during rainy and harmattan (dry) seasons (September-December 2000 and June-July 2001, respectively) using a gill net. The specimens were cut open and the full length of the stomach was immersed in 4 per cent formalin. These were transported to the laboratory for further examination. Each stomach was slit open, the contents poured into a petri dish and observations of the food were carried out with the naked eye. Following this, random samples of the stomach contents were dropped on slides with the aid of a dropping pipette and observed under a light microscope. The stomach contents were analyzed using the Frequency of Occurrence method and the Numerical method (Bagenal 1978). Food items present were identified at the general level, whenever possible, using information provided by Prescott (1954).

In the Frequency of Occurrence method, the number of stomachs containing each food item is expressed as a percentage of all non-empty stomachs (Dunn 1954). Though this method is quick and requires minimal apparatus, it gives little indication of the relative quantities of each food category present in the stomach.

In the Numerical method, the number of individuals in each food category is expressed as a percentage of the total individuals in all food categories (e.g. Crisp et al. 1978). This method has the limitation that it over-emphasizes the importance of small prey items found in a large number of fish (Hynes 1950). For many stomachs, it is difficult to identify the numbers in each food category because of mastication of the food. It is also not suitable for dealing with food items such as fragments and detritus that do not occur in discrete units. Occasionally, some food items were observed crushed and others were at varying stages of digestion. Consequently, it was not possible to identify these at the species level.

Results

The results show that *S. nigrita* has a wide feeding range. The food composition of *S. nigrita* also shows a marked seasonal variation. The food range becomes drastically limited in the dry season (October-December) when the occurrence shows *Polycystis* spp., *Closterium* spp., *Oedogonium* spp., insect parts, detritus and plant tissues as predominant in the stomach contents of *S. nigrita* (Table 1). In the dry season, when the water becomes depleted and less fertile to support the plankton bloom which is characteristic of the rainy season, food items such as insect parts, nematodes, plant tissues and algae

become the food items for survival in the diet of *S. nigrita*. Generally, *S. nigrita* has a wide range of food items in the rainy season when there is an abundance of plankton and insects in the water.

The food category "algae" includes all green and blue-green forms, both unicellular and filamentous as well as diatoms. The predominant forms found in the stomach were *Polycystis, Closterium, Oedogonium* and the diatoms *Diatoma sp.*, insect parts, detritus and plant tissues. Monthly variations in stomach fullness and the percentage of empty stomachs are given in Table 2.

Discussion

The food items in the stomach of *S. nigrita* suggest that they are euryphagous (i.e. feeding on a wide range of organisms). It was also observed that *S. nigrita* can be classified as an omnivorous feeder as the diet covers a wide spectrum of food ranging from various types of plankton to invertebrates and plants. The fish also exhibits an overlapping in food and feeding habits in order to avoid inter- and intra-specific competition for available food. This is an important strategy for survival and an advantage over the fish species competing for a specific food item. This explains the availability of *S. nigrita* all year round.

The ventral location of the mouth of *S. nigrita* encourages a detritivorous mode of feeding while the simple horny structures around the mouth enable it to adapt to filter feeding. These structures also help *S. nigrita* to gnaw at any hard plant tissue or insect parts which form part of its rich diet.

Monthly/seasonal variations in feeding habits showed an increase in the stomach fullness during the rainy season and decreases in the dry season. The proportion of empty stomachs was higher in the dry season (Table 1). This may reflect a steady dwindling of food resources in a habitat that is continually decreasing in volume with the onset of the dry season. Some of the variability in the dietary composition of *S. nigrita* may be explained on the basis of the change in water level. During the rainy season, there is a wide variety and abundance of food available due to high nutrient composition of the run-off from land promoting plant growth and increasing invertebrate productivity (Moss 1980). This is reflected in the range of food items found in *S. nigrita* captured from June to September, i.e. in the rainy season (Table 1). As the dry season approaches, the river becomes shallow and the abundance and variety of food decrease. The *S. nigrita* changes its dietary composition to algae, insect parts, nematodes, detritus and plant tissues predominantly from October to December (Table 1). This agrees with the findings of Hyslop (1986).

The seasonal change in temperature as a result of *harmattan* winds from the Sahara desert may also play an important role in reducing food availability and diversity. While the diversity of the *S. nigrita* diet decreases, there are also major changes in its composition. A greater percentage of algae, detritus and insect parts during the dry season and the inclusion of crustaceans and rotifers during the rainy season are the main changes in the dietary composition.

The study indicates the preference of *S. nigrita* for phytoplankton, detritus, plant tissues and insect parts (Table 2), which constituted more than 90 per cent of the stomach contents in the dry season. This preference is probably due to the seasonal predominance of these food items in the environment. The phytoplankton found in the stomach contents were mostly Cyanophyta, represented by *Polycystis* spp. and *Clsosterium* spp., *Oedogonium* spp. (Chlorophyta) and unidentified algae (Table 2). *S. nigrita* is not only a phytoplankton feeder, but it also feeds on a little quantity of zooplankton, like rotifers and crustaceans that are represented by cladocerans (*Daphnia sp*). The ingestion of detritus was earlier observed by Patrick - Dempster et al. (1993) for *Tilapia* species and carp, indicating that part of the ingested materials came from the bottom of the river. Protozoans that are typical of the river bottom fauna were found in the digestive tract of *S. nigrita*. Sand grains were also found.

The overall picture of the diet of *S. nigrita* that emerges from this study is that of a species which is largely unspecialized in its feeding habits. Unspecialized flexible dietary habits are an optimal strategy for survival in habitats where food sources are subject to fluctuation (Welcomme 1979). Similarly, the inclusion of large amounts of detritus in the diet is of survival value. It is derived from the surrounding terrestrial habitats and is abundant in the river throughout the season. It also appears that growth proceeds satisfactorily with a sizeable proportion of plant material in the diet. The maximum size of *S. nigrita* obtained from the Osun River was 110.86 g in the rainy season. Hyslop (1986) made a similar observation in his study of *Clarias anguillaris* from the Sokoto flood plains.

The ability of *S. nigrita* to feed at a number of different trophic levels coupled with the potential for fast growth make this species a promising candidate for commercial culture. As the species is widely used as human food throughout the area in which it occurs, it could easily be incorporated into locally operated polyculture systems with minimal inputs of expensive animal protein in the feed. (Hyslop 1986).

References

Adebisi, A.A. 1981. Analysis of the stomach contents of the piscivorus fishes of the upper Ogun River in Nigeria. Hydrobiologia 79:167-177.

Aramowo, G.A. O. 1976. Food and Feeding of three *Citharinus* species in Lake Kainji, Nigeria. J. Fish Biol. 9:3-10.

Bagenal, T. 1978. Methods for assessment of fish production in fresh waters. Blackwell Scientific Publications, Oxford.

Crisp, D. P., R. H. K. Mann and J. C. McCormack. 1978. The effects of impoundment and regulation upon the stomach contents of fish at Cowgreen, upper Teesdale. J. Fish Biol. 12:287-301.

Dunn, D. R. 1954. The feeding habits of some of the fishes and some members of the bottom fauna of Llyn Tegid (Bala Lake), Merionethshire. J. Anim. Ecol. 23:224-233.

Fagade, S. O. 1971. The food and feeding habits of *Tilapia species* from the Lagos Lagoon. J. Fish Biol. 3:151-156.

Fagade, S. O. 1978. The Biology of *Tilapia guineensis* (Dumeril) from the Lekki Lagoon, Lagos State, Nigeria. Nig. J. Sc. 12:73-83.

Fagade, S. O. and C. I. O. Olaniyan. 1973. The food and feeding interrelationship

Table 1. Composition of stomach contents of *Synodontis nigrita* by month

	Sept.		Oct.		Nov.		Dec.		Jun.		Jul.	
No. examined	53		45		34		34		70		85	
% empty stomach	7.6		26.7		35.3		47.1		27.1		30.6	
Food items	%N	%0	%N	%0	%0	%N	%N	%0	%N	%0	%N	%0
BASCILLARIOPHYCEAE												
Diatoma sp.	6.4	71.4	-	-	4.6	96.7	-	-	1.5	84.3	1.6	66.1
Synadra sp.	2.2	30.6	-	-	-	-	-	-	1.0	33.3	1.0	25.4
Gymnodium sp.	2.4	30.7	-	-	-	-	-	-	0.9	31.4	0.9	27.1
Nitzchia sp.	1.0	20.4	-	-	-	-	-	-	0.6	19.6	0.6	25.4
Stephanodiscus sp.	1.0	26.5	-	-	-	-	-	-	0.3	17.7	0.3	32.2
CYANOPHYCEAE												
Lyngbya sp.	0.4	28.6	-	-	-	-	-	-	0.3	19.6	0.4	18.6
Polycystis sp.	10.2	100.0	23.6	100.0	17.1	100.0	26.8	100.0	10.8	100.0	10.5	100.0
Aphanocapsa sp.	1.9	40.75	-	-	-	-	-	-	3.0	58.8	3.0	69.5
Closterium sp.	8.5	71.4	14.8	100.0	14.0	100.0	19.1	100.0	10.4	94.1	10.0	100.0
Coelosphaerium sp.	2.9	59.2	-	-	-	-	-	-	4.5	70.6	4.4	55.6
Microcystis sp.	1.7	26.5	-	-	-	-	-	-	2.3	23.5	2.3	28.8
Oscillatoria sp.	0.9	14.3	-	-	-	-	-	-	0.3	11.8	0.3	15.3
Spirotaenia sp.	0.02	6.1	-	-	-	-	-	-	0.3	5.9	0.4	11.9
CHLOROPHYCEAE												
Oedogonium sp.	8.1	91.9	17.4	75.8	10.7	100.0	-	-	10.4	96.1	10.0	96.6
Ulothrix sp.	2.1	61.2	-	-	-	-	-	-	3.3	60.7	3.6	59.3
Sphaeoplea sp.	1.0	67.4	-	-	-	-	-	-	4.1	62.8	3.9	76.3
Unidentified algae	7.2	100.0	-	-	-	-	-	-	9.8	100.0	9.3	100.0
ROTIFERS												
Polyarthra sp.	1.6	20.4	-	-	-	-	-	-	1.1	39.2	1.0	47.5
Kerattela sp.	1.3	20.4	-	-	-	-	-	-	1.2	39.2	1.2	40.7
Epiphanes sp.	0.6	28.6	-	-	-	-	-	-	0.5	52.9	0.4	50.5
Synchaeta sp.	0.8	24.5	-	-	-	-	-	-	0.3	49.0	0.9	45.8
Asplanchna sp.	0.7	12.3	-	-	-	-	-	-	0.5	59.4	0.4	28.8
Philodina sp.	0.8	36.7	-	-	-	-	-	-	0.3	54.9	0.3	44.1
CRUSTACEA												
Cladocerans												
Daphnia sp.	2.9	59.2	-	-	-	-	-	-	3.3	39.2	4.3	39.0
Eurycerus sp.	0.08	24.5	-	-	-	-	-	-	0.2	24.5	0.1	22.0
Ceriodaphnia sp.	3.0	26.5	-	-	-	-	-	-	-	-	0.1	17.00
Decapods												
Syncaris sp.	0.1	40.8	-	-	-	-	-	-	-	-	0.1	8.5
Copepods												
Cyclops sp.	-	-	-	-	-	-	0.7	88.9	-	-	-	-
PROTOZOA												
Frontonia sp.	0.4	26.5	-	-	-	-	-	-	0.3	25.5	0.1	6.8
Paramecium sp.	0.5	10.2	-	-	-	-	-	-	0.2	9.8	-	-
Nematodes NEMATODA	0.5	30.6	0.7	90.9	0.3	50.0	1.2	100.0	3.8	54.8	3.7	35.0
Insect parts	7.3	71.4	28.4	100.0	17.1	100.0	14.5	100.0	2.3	29.4	2.4	33.9
Detritus	11.2	100.0	14.1	100.0	-	-	13.3	100.0	9.0	98.0	8.5	88.1
Unidentified food	5.1	93.9	1.0	60.7	-	-	7.4	50.0	3.3	76.5	4.3	72.9
Plant tissues	5.3	98.0	-	-	9.9	100.0	-	-	10.2	100.0	10.0	100.0

%N - percentage number
%O - percentage occurrence

of the fishes of the Lagos lagoon. J. Fish Biol. 5:205-227.
Fagade, S. O. and C. I. O. Olaniyan. 1978. The food of Tilapia species in Lake Kainji. J. Fish Biol. 4:138-150.
Fish, G. R. 1955. The food of Tilapia in East African Uganda. J. Fish Biol. 19:85-89.
Holden, M. J. 1970. The feeding habits of *Alestes baremose* and *Hydrocynus forskahlii* (Pisces) in Lake Albert, East African. J. Zool. London. 161:137-144.
Hynes, H. B. N. 1950. The food of freshwater sticklebacks *(Gasterosteus aculeatus and Pygosteus pungitius*), with a review of methods used in studies of the food of fishes. J. Anim. Ecol.19: 36-58.
Hyslop, E. J. 1986. The growth and feeding habits of *Clarias anguillaris* during their first season in the flood plain pools of the Sokoto-Rima River Basin, Nigeria. J. Fish Biol. 30:183-192.
Moss, B. 1980. Ecology of fresh waters. Blackwell Scientific Publication, Oxford.
Patrick-Dempster, P. G. M. Mallon and D. B. Beveridge. 1993. Production de peces herbivoros en sistemas semi-intensive, p. 224-246. *In* XII Reunion Asso. Latino - Americana de production animal, Santiago de Chile.
Prescott, G. W. 1954. The Freshwater Algae. W. M. C. Brown Company Publishers, Dubuque, Iowa.
Welcomme, R. L. 1979. Fisheries Ecology of flood plain rivers. Longman, London.

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Table 2. Summary of the stomach contents of the total number of *Synodontis nigrita* sampled

	Frequency of occurence method		**Numerical method**	
Food items	No. of occurrences	%0	No.	%N
BASCILLARIOPHYCEAE				
Diatoma sp	137	59.1	4186	2.7
Synadra sp.	47	20.3	1.8	1.2
Gymnodinium sp.	47	20.3	17.8	1.1
Nitzchia sp.	35	15.1	960	0.6
Stephanodiscus sp.	41	17.7	658	0.4
CYANOPHYCEAE				
Lyngbya sp.	35	15.1	528	0.3
Polycystis sp.	232	100	17863	11.5
Aphanocapsa sp.	91	39.2	3892	2.5
Closterium sp.	215	92.7	160.1	10.3
Ceolosphaerium sp.	98	42.2	58.1	3.7
Microcystis sp.	42	18.1	3	1.9
Oscillatoria sp.	22	9.5	627	0.4
Spyrotaenia sp	110	47.4	4593	2.9
ROTIFERS				
Polyarthra sp.	58	25.0	1676	1.1
Keratellla sp.	54	23.3	1719	1.1
Epiphanes sp.	71	30.6	677	0.4
Synchaeta sp.	64	27.6	931	0.6
Asplanchna sp.	38	16.4	712	0.5
Philodina sp.	72	31.0	583	0.4
CRUSTACEA CLADOCERANS				
Daphnia sp.	72	31.0	5145	3.3
Eurycerus sp.	39	16.8	186	0.1
Ceriodaphnia sp.	23	9.9	1133	0.7
Decapodes				
Syncaris sp.	25	10.8	107	1.0
Copepods				
Cyclops sp.	16	6.9	22	0.01
PROTOZOA				
Frontonia sp.	30	12.9	367	0.2
Paramecium sp.	10	4.3	236	0.2
Nematodes NEMATODA	125	53.9	4261	2.7
Insect parts	143	61.6	7804	5.0
Detritus	202	87.1	14500	9.3
Unidentified Food	157	67.7	6155	3.9
Plant tissues	180	77.6	13530	8.7

%O - percentage of occurrence
%N - percentage of number
Percentage empty stomachs: 27.73%
Percentage of full stomachs: 72.27%
Total number examined: 321 stomachs